CLAIMS

1. A method of planarizing a microelectronic substrate, comprising:

positioning a fixed-abrasive planarizing pad on a table of a planarizing machine, the fixed-abrasive pad having a planarizing medium with an abrasive planarizing surface, the planarizing medium comprising a binder and a plurality of first abrasive particles fixedly attached to the binder, wherein at least a share of the first abrasive particles are exposed at the planarizing surface;

covering at least a portion of the planarizing surface with a first planarizing solution having a liquid and a plurality of second abrasive particles suspended in the liquid at a first stage of a planarizing cycle of a microelectronic substrate assembly;

rubbing the microelectronic substrate against the first abrasive particles at the planarizing surface and the second abrasive particles suspended in the first planarizing solution; and

coating the planarizing surface with a second planarizing solution at a second stage of the planarizing cycle, the second planarizing solution being a non-abrasive solution without abrasive particles.

2. The method of claim 1 wherein the first stage comprises dispensing a fixed volume of the first planarizing solution onto the planarizing pad before rubbing the microelectronic substrate against the planarizing pad.

3. The method of claim 1 wherein the first stage comprises effecting a flow of the first planarizing solution onto the planarizing pad and terminating the flow of the first solution before rubbing the microelectronic substrate against the planarizing pad.

4. The method of claim 1 wherein the first stage comprises an initial stage of the planarizing cycle.

5. The method of claim 1 wherein the first stage comprises pre-wetting of the planarizing pad before rubbing the microelectronic substrate against the planarizing pad.

6. The method of claim 1 wherein the first stage comprises effecting a flow of the first planarizing solution onto the planarizing pad while rubbing the microelectronic substrate against the planarizing pad before the second stage.

7. The method of claim 1 wherein:

the first stage comprises effecting a flow of the first planarizing solution at an initial stage of the planarizing cycle and then terminating the flow of the first planarizing solution; and

the second stage comprises effecting a flow of the second planarizing solution after terminating the flow of the first planarizing solution.

8. The method of claim 7, further comprising:

monitoring a surface condition of the microelectronic substrate; and

effecting the flow of the second solution comprises starting the flow of the second solution upon detecting a change in the surface condition.

9. The method of claim 8 wherein monitoring a surface condition comprises monitoring a drag force between the microelectronic substrate and the planarizing pad.

10. The method of claim 1 wherein:

the first stage comprises effecting a flow of the first planarizing solution at an initial stage of the planarizing cycle; and

the second stage comprises subsequently effecting a flow of the second planarizing solution while continuing the flow of the first planarizing solution to deposit a combination of the first and second planarizing solutions on the planarizing pad.

11. The method of claim 10, further comprising:

monitoring a change in surface condition of the microelectronic substrate; and

effecting the flow of the second solution comprises starting the flow of the second solution upon detecting a change in the surface condition.

12. The method of claim 11 wherein monitoring a surface condition comprises monitoring a drag force between the microelectronic substrate and the planarizing pad.

13. The method of claim 1 wherein:

the first stage comprises effecting a flow of the first planarizing solution at an initial stage of the planarizing cycle and then terminating the flow of the first planarizing solution;

the second stage comprises effecting a flow of the second planarizing solution after terminating the flow of the first planarizing solution during an opening phase of the second stage; and

re-effecting the flow of the first planarizing solution upon detecting a surface condition of the substrate at a subsequent phase of the second stage of the planarizing cycle.

14. The method of claim 13 wherein re-effecting the flow of the first planarizing solution further comprises terminating the flow of the second solution during the subsequent phase of the second stage of the planarizing cycle.

15. The method of claim 13 wherein re-effecting the flow of the first planarizing solution further comprises continuing the flow of the second solution during the subsequent phase of the planarizing cycle.

16. The method of claim 1 wherein:

the first abrasive particles in the planarizing medium and the second abrasive particles in the first planarizing solution have the same composition; and

rubbing the microelectronic substrate against the first and second abrasive particles comprises abrading the microelectronic substrate with the first and second abrasive particles.

17. The method of claim 1 wherein:

the first abrasive particles in the planarizing medium have a first composition and the second abrasive particles in the first planarizing solution have a second composition different than the first composition; and

rubbing the microelectronic substrate against the first and second abrasive particles comprises abrading the microelectronic substrate with the first and second abrasive particles.

18. The method of claim 1 wherein:

the first abrasive particles in the planarizing medium have a first size and the second abrasive particles in the first planarizing solution have a second size different than the first size; and

rubbing the microelectronic substrate against the first and second abrasive particles comprises abrading the microelectronic substrate with the first and second abrasive particles.

19. The method of claim 1 wherein:

the first abrasive particles in the planarizing medium have a first shape and the second abrasive particles in the first planarizing solution have a second shape different than the first shape; and

rubbing the microelectronic substrate against the first and second abrasive particles comprises abrading the microelectronic substrate with the first and second abrasive particles.

20. A method of planarizing a microelectronic substrate, comprising:

positioning a fixed-abrasive planarizing pad on a table of a planarizing machine, the fixed-abrasive pad having a planarizing medium with an abrasive planarizing

surface, the planarizing medium comprising a binder and a plurality of first abrasive particles fixedly attached to the binder, wherein at least a share of the first abrasive particles are exposed at the planarizing surface;

covering at least a portion of the planarizing surface with an abrasive first planarizing solution having a plurality of second abrasive particles during an initial stage of a planarizing cycle of a microelectronic substrate assembly;

pressing the microelectronic substrate against the first abrasive particles at the planarizing surface and the second abrasive particles suspended in the first planarizing solution, and moving the microelectronic substrate and/or the planarizing pad to rub the microelectronic substrate against the planarizing surface; and

reducing a concentration of the second abrasive particles on the planarizing surface at a subsequent stage of the planarizing cycle after the initial stage.

21. The method of claim 20 wherein reducing the concentration of second abrasive particles on the planarizing surface comprises dispensing a non-abrasive second planarizing solution without abrasive particles onto the planarizing pad.

22. The method of claim 21 wherein covering the planarizing surface with the second abrasive particles comprises dispensing the first planarizing solution onto the polishing pad.

23. The method of claim 21, further comprising terminating dispensing the first planarizing solution before dispensing the second planarizing solution.

24. The method of claim 21 wherein covering the planarizing surface with the second abrasive particles comprises dispensing the first planarizing solution onto the polishing pad during the initial stage and the subsequent stage of the planarizing cycle.

25. The method of claim 24 wherein the first planarizing solution is continuously dispensed during the initial and subsequent stages of the planarizing cycle.

26. A method of planarizing a microelectronic substrate, comprising:

positioning a fixed-abrasive planarizing pad on a table of a planarizing machine, the fixed-abrasive pad having a planarizing medium with an abrasive planarizing surface, the planarizing medium comprising a binder and a plurality of first abrasive particles fixedly attached to the binder, wherein at least a share of the first abrasive particles are exposed at the planarizing surface;

covering at least a portion of the planarizing surface with an abrasive first planarizing solution having a plurality of second abrasive particles during a first stage of a planarizing cycle of a microelectronic substrate assembly;

pressing the microelectronic substrate against the first abrasive particles at the planarizing surface and the second abrasive particles suspended in the first planarizing solution, and moving the microelectronic substrate and/or the planarizing pad to rub the microelectronic substrate against the planarizing surface; and

adjusting a concentration of the second abrasive particles on the planarizing surface at a second stage of the planarizing cycle after the first stage.

27. The method of claim 26 wherein adjusting the concentration of second abrasive particles on the planarizing surface comprises dispensing a second non-abrasive planarizing solution without abrasive particles onto the planarizing pad.

28. The method of claim 27 wherein covering the planarizing surface with the second abrasive particles comprises dispensing the first planarizing solution onto the polishing pad.

29. The method of claim 27, further comprising terminating dispensing the first planarizing solution before dispensing the second planarizing solution.

30. The method of claim 27 wherein covering the planarizing surface with the second abrasive particles comprises dispensing the first planarizing solution onto the

polishing pad during the first stage and a subsequent phase of the second stage of the planarizing cycle.

31. The method of claim 27 wherein the first planarizing solution is continuously dispensed during the first and second stages of the planarizing cycle.

32. A planarizing machine for mechanical and/or chemical-mechanical planarization of microelectronic substrates, comprising:

a table having a support surface;

a fixed-abrasive planarizing pad on the support surface of the table, the fixed-abrasive pad having a planarizing medium with an abrasive planarizing surface, the planarizing medium comprising a binder and a first plurality of abrasive particles fixedly attached to the binder, wherein at least a share of the first abrasive particles are exposed at the planarizing surface;

a carrier assembly having a head for holding a substrate assembly and a drive mechanism for moving the head relative to the planarizing pad;

a first supply of an abrasive first planarizing solution coupled to a dispenser positionable over the planarizing pad, wherein the first planarizing solution has a liquid and a second plurality of abrasive particles suspended in the liquid;

a second supply of a second planarizing solution coupled to the dispenser, wherein the second planarizing solution is a non-abrasive solution without abrasive particles; and

a computer operatively coupled to the first supply of the first planarizing solution and the second supply of the second planarizing solution, the computer having a computer-readable medium containing a computer-readable program code that causes the computer to (a) effect a first flow of the first planarizing solution to the dispenser at a first stage of a planarizing cycle of a microelectronic substrate, and (b) effect a second flow of the second planarizing solution to the dispenser at a second stage of the planarizing cycle after the first stage.

33. The planarizing machine of claim 32 wherein the computer-readable program code comprises causing the computer to open a first valve coupled to the first supply during the first stage to dispense a fixed volume of the first planarizing solution onto the planarizing pad before rubbing the microelectronic substrate against the planarizing pad.

34. The planarizing machine of claim 32 wherein the computer-readable program code comprises causing the computer to open a first valve coupled to the first supply during the first stage to effect the flow of the first planarizing solution onto the planarizing pad and then to close the first valve to terminate the flow of the first solution before rubbing the microelectronic substrate against the planarizing pad.

35. The planarizing machine of claim 32 wherein the computer-readable program code comprises causing the computer to open a first valve coupled to the first supply during the first stage to effect the flow of the first planarizing solution onto the planarizing pad while rubbing the microelectronic substrate against the planarizing pad before the second stage.

36. The planarizing machine of claim 32 wherein:

the computer-readable program code comprises causing the computer to open a first valve coupled to the first supply during the first stage to effect the flow of the first planarizing solution and then to close the first valve to terminate the flow of the first planarizing solution; and

the computer-readable program code comprises causing the computer to open a second valve coupled to the second supply during the second stage to effect the flow of the second planarizing solution after terminating the flow of the first planarizing solution.

37. The planarizing machine of claim 32 wherein:

the computer-readable program code comprises causing the computer to open a first valve coupled to the first supply during the first stage to effect the flow of the first planarizing solution; and

the computer-readable program code comprises causing the computer to open a second valve coupled to the second supply during the second stage to subsequently effect the flow of the second planarizing solution while continuing the flow of the first planarizing solution to deposit a combination of the first and second planarizing solutions on the planarizing pad.

38. The planarizing machine of claim 32 wherein:

the computer-readable program code comprises causing the computer to open a first valve coupled to the first supply during the first stage to effect the flow of the first planarizing solution and then to close the first valve to terminate the flow of the first planarizing solution;

the computer-readable program code comprises causing the computer to open a second valve coupled to the second supply during the second stage to effect the flow of the second planarizing solution after terminating the flow of the first planarizing solution during an opening phase of the second stage; and

the computer-readable program code comprises causing the computer to re-open the first valve to re-effect the flow of the first planarizing solution upon detecting a surface condition of the substrate at a subsequent phase of the second stage of the planarizing cycle.

39. The planarizing machine of claim 32 wherein the first abrasive particles in the planarizing medium and the second abrasive particles in the first planarizing solution have the same composition.

40. The planarizing machine of claim 32 wherein the first abrasive particles in the planarizing medium have a first composition and the second abrasive particles in the first planarizing solution have a second composition different than the first composition.

41. The planarizing machine of claim 32 wherein the first abrasive particles in the planarizing medium have a first size and the second abrasive particles in the first planarizing solution have a second size different than the first size.

42. The planarizing machine of claim 32 wherein the first abrasive particles in the planarizing medium have a first shape and the second abrasive particles in the first planarizing solution have a second shape different than the first shape.

43. A planarizing machine for mechanical and/or chemical-mechanical planarization of microelectronic substrates, comprising:

a table having a support surface;

a fixed-abrasive planarizing pad on the support surface of the table, the fixed-abrasive pad having a planarizing medium with an abrasive planarizing surface, the planarizing medium comprising a binder and a first plurality of abrasive particles fixedly attached to the binder, wherein at least a share of the first abrasive particles are exposed at the planarizing surface;

a carrier assembly having a head for holding a substrate assembly and a drive mechanism for moving the head relative to the planarizing pad;

a first supply of an abrasive first planarizing solution coupled to a dispenser positionable over the planarizing pad, wherein the first planarizing solution has a liquid and a second plurality of abrasive particles suspended in the liquid;

a second supply of a second planarizing solution coupled to the dispenser, wherein the second planarizing solution is a non-abrasive solution without abrasive particles; and

a computer operatively coupled to the first supply of the first planarizing solution and the second supply of the second planarizing solution, the computer having a computer-readable medium containing a computer-readable program code that causes the computer to effect (a) a flow of the first planarizing solution to the dispenser at a first stage of a planarizing cycle of a microelectronic substrate, and (b) a reduction of a concentration of the first abrasive particles on the planarizing pad during a second stage of the planarizing cycle after the first stage.

44. The planarizing machine of claim 43 wherein the computer-readable program code comprises causing the computer to effectuate a flow of a non-abrasive second

planarizing solution without abrasive particles onto the planarizing pad during the second stage of the planarizing cycle.

45. The planarizing machine of claim 44 wherein the computer-readable program code comprises causing the computer to terminate the flow of the first planarizing solution at the end of the first stage before effectuating the flow of the second planarizing solution at the commencement of the second stage.

46. The planarizing machine of claim 44 wherein the computer-readable program code comprises causing the computer to continuously maintain the flow of the first planarizing solution during the first and second stages of the planarizing cycle.

47. A planarizing machine for mechanical and/or chemical-mechanical planarization of microelectronic substrates, comprising:

a table having a support surface;

a fixed-abrasive planarizing pad on the support surface of the table, the fixed-abrasive pad having a planarizing medium with an abrasive planarizing surface, the planarizing medium comprising a binder and a first plurality of abrasive particles fixedly attached to the binder, wherein at least a share of the first abrasive particles are exposed at the planarizing surface;

a carrier assembly having a head for holding a substrate assembly and a drive mechanism for moving the head relative to the planarizing pad;

a first supply of an abrasive first planarizing solution coupled to a dispenser positionable over the planarizing pad, wherein the first planarizing solution has a liquid and a second plurality of abrasive particles suspended in the liquid;

a second supply of a second planarizing solution coupled to the dispenser, wherein the second planarizing solution is a non-abrasive solution without abrasive particles; and

a computer operatively coupled to the first supply of the first planarizing solution and the second supply of the second planarizing solution, the computer having a

computer-readable medium containing a computer-readable program code that causes the computer to effect the method of claim 26.

48. The planarizing machine of claim 47 wherein the computer-readable program code comprises causing the computer to effectuate a flow of a non-abrasive second planarizing solution without abrasive particles onto the planarizing pad during a second stage of the planarizing cycle.

49. The planarizing machine of claim 48 wherein the computer-readable program code comprises causing the computer to terminate the flow of the first planarizing solution at the end of a first stage of the planarizing cycle before effectuating the flow of the second planarizing solution at the commencement of the second stage of the planarizing cycle.

50. The planarizing machine of claim 48 wherein the computer-readable program code comprises causing the computer to continuously maintain the flow of the first planarizing solution during a first stage and a second stage of the planarizing cycle.